When the radio "spoke".

A. S. Popov - father of sound radio

V. Merkulov

The radio that appeared at the end of the 19th century was dumb, unable to transmit sound. The article published here reviews the events preceding the start of widespread broadcasting.

After invention A. Bell (1847-1922) of the telephone in 1876 and the implementation of N. Tesla (1856-1943) in the 1890s, experimental work that showed the ability of electromagnetic (EM) waves to travel tens of kilometers in space, the idea of telephony without wires began to “float” in the air". The first, fully aware of the significance of the broadcasts of the human voice and music, was an American engineer of Canadian origin R. Fessenden (1866-1932).

Amplitude Modulation Sunrise

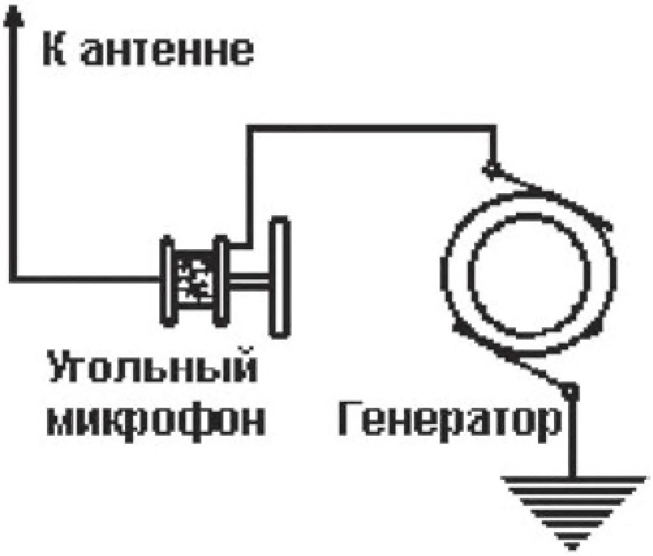


Fig. one

Fez Senden began experiments on wireless broadcasting of audio signals in early 1900, working in the agronomy department of the American Weather Bureau (ABP). There, for the first time, they were asked to place a microphone in the transmitter in a circuit connecting the RF signal generator and the antenna (Fig. 1). The method is called “amplitude modulation” (AM).

Coherer used in receivers of the inventor of radio A. FROM . Popov (1859-1906) and his follower Mr. Marconi (1874-1937) were not suitable for the undistorted reproduction of speech and musical signals. For this reason, Fessenden tried to introduce a less excitable liquid separator into the receiver. The resulting receiving and transmitting system allowed him to hear an intermittent sound tone at a distance of 1.6 km (1 mile).

Tests of the equipment took place in the town of Kob - Iceland (Maryland), located on the Potomac River of the same name, 75 km away. south of Washington. EM oscillations were generated by a spark generator. There were no relays in the receiver. An electrolytic detector, which received the name of a barreter, detected incoming signals in it. It was suitable for listening to both telephone and telegraph parcels. A wide range of emitted high frequencies did not contribute to the high-quality reception of the sound component. The broadcast was “noisy”. With all this, she allowed Fessenden to establish his intention to continue work.

Fessenden decided to abandon the spark generator and began to consider a communication system based on undamped EM oscillations. However, in 1902, he had to resign from the ABP, since the head of the department demanded half participation in the patents issued by Fessenden.

Wireless telephony research was continued at the electrical company NESCO (National Electric Signaling Company). Here it was established by experiments and experiments that continuous sinusoidal oscillations are more suitable for transferring sound frequencies (SP) over the ether. Long and medium waves were identified as the most suitable for AM.

At the beginning of the twentieth century, only machine (motor) generators were capable of generating oscillations of these waves. They were developed at NESCO by a young specialist, E. Alexanderson (1878-1975), who immigrated from Sweden. At that time, the rotors of the best alternating current energy sources could rotate at a frequency of 10,000 s **–1** . Fessenden formulated a technical proposal for the development of a pathogen with a frequency of 100 kHz and a power of several kilowatts. Alexanderson accepted a task that did not meet the realities.

The first transatlantic "air bridge"

The development of a “high-speed” generator, which began jointly with Alexanderson, allowed Fessenden to further explore the possibilities of his own receiver in interaction with electromagnetic oscillations of a spark source [1]. The Brant Rock Village on the shores of the Atlantic Ocean (Massachusetts, 50 km south of Boston) began to serve as a proving ground. From there, it was decided to "throw" the signal to the other side of Scotland in the town of Makherihenish. Antennas 128 and 137 m high respectively were built in these settlements, raised on tubular metal masts with a diameter of 0.92 m at the base. The receiver intended for the early detection of weak signals contained an inductively capacitive circuit and headphones at the output.

The first communication trials took place at the end of December 1905. However, a stable exchange of telegraphic messages “by ear” was established only on January 14, 1906. Unlike the trial one-way transatlantic sending of one letter S carried out by Marconi in 1901, the reception of which, besides him himself, no one had heard, telegrams went both ways without errors and contained up to 40 words. Attempts to broadcast musical and voice messages across the ocean this time failed.

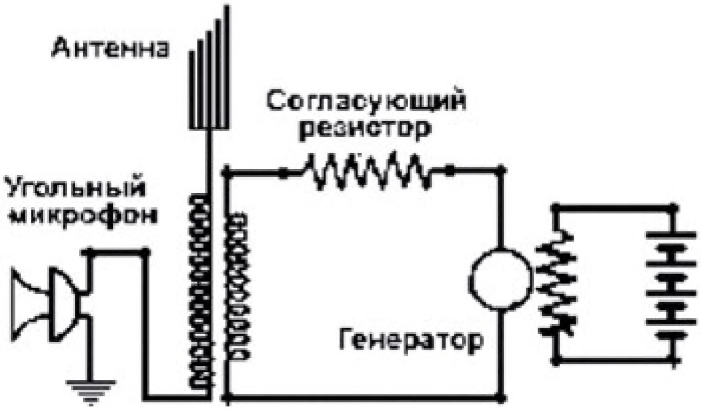
Duty on a record air line made it possible to establish that long waves are less prone to attenuation in the dark, therefore, winter seasons, when the days are shorter, are preferred for extra long communication. The accumulated empirical experience subsequently helped Marconi avoid many mistakes when commissioning the air line connecting America with Europe.

The wireless “bridge” functioned until December 5, 1906, when the antenna mast was demolished by a gust of strong wind on the European shore.

Demonstrations

In August 1906, Fessenden began testing the 50 kHz motor sinusoidal generator completed in production, but with a power slightly less than expected. Replacing the source of EM oscillations in the receiving and transmitting system fully paid off. The amplitude-modulated EM waves emitted by the antenna with a length of 6,000 m are captured in places 100 km away from Brant-Rock. and further.

On December 21, 1906, the developed devices were shown to leading executives and electrical engineers of AT&T, GENERAL ELECTRIC, WESTERN ELECTRIC, WESTINGHOUSE ELECTRIC (WHE), including prominent American professors: inventor E. Thomson (1853-1937), physicist-theoretician BUT . Kenneli (1861-1939), to some correspondents of the New York newspapers. Comparative tests were conducted on the quality of the transmission of sound signals by wire and by air in Plymouth, Massachusetts, at a distance of 25 km and Boston at 50 km [1]. Listeners recognized the communication lines as identical.



Fessenden was aware of the failures associated with the initial distribution of the sound recording invented by T. Edison (1847-1931) in 1877. In the list of applicability of the innovation announced at the presentations, the first positions included the training of parrots or dogs and the preparation of voiced wills. Music took the last place. Over the years, finally came the insight and realization that the recordings are more suitable for the dissemination of musical culture and news. It is significant that at the same time in the United States and Europe, telephone

Fig. 2

companies began to provide services for the remote listening of concerts from opera houses.

Fessenden tried to avoid Edison’s methodological miscalculation. Therefore, in the action taken, he drew the attention of specialists to the ability of his equipment to transmit and receive not only verbal dialogs, but also art genres - individual and choral singing, playing string instruments, and phonograph records. For the first time, he demonstrated the transfer of music on air and the possibility of arranging its transfers from a remote center on a schedule, without wireless.

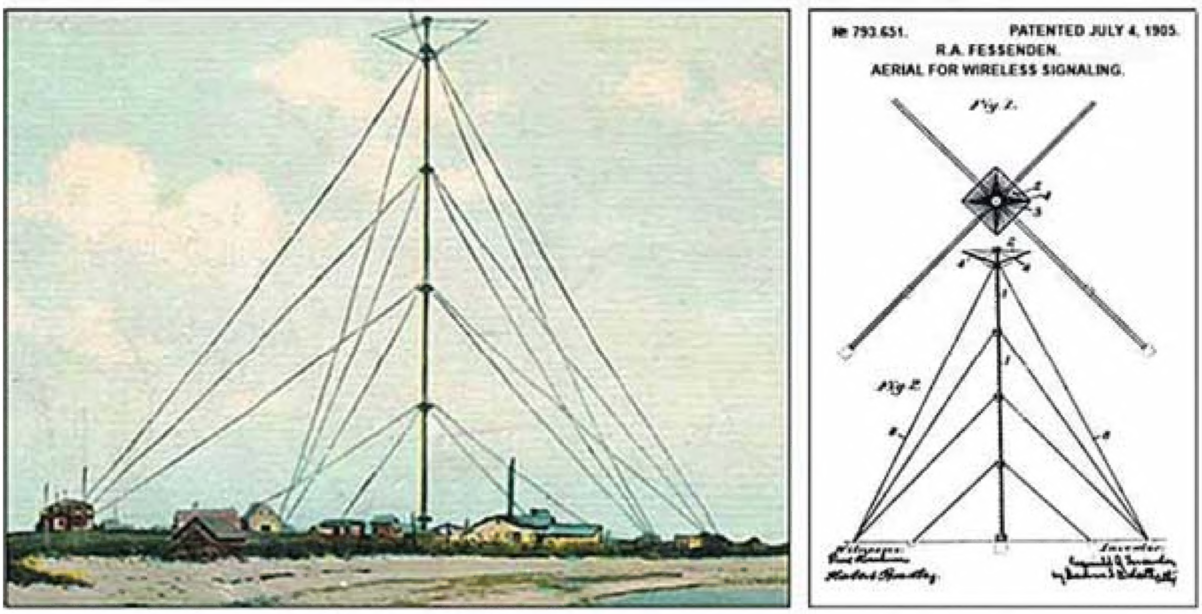


Fig. 3

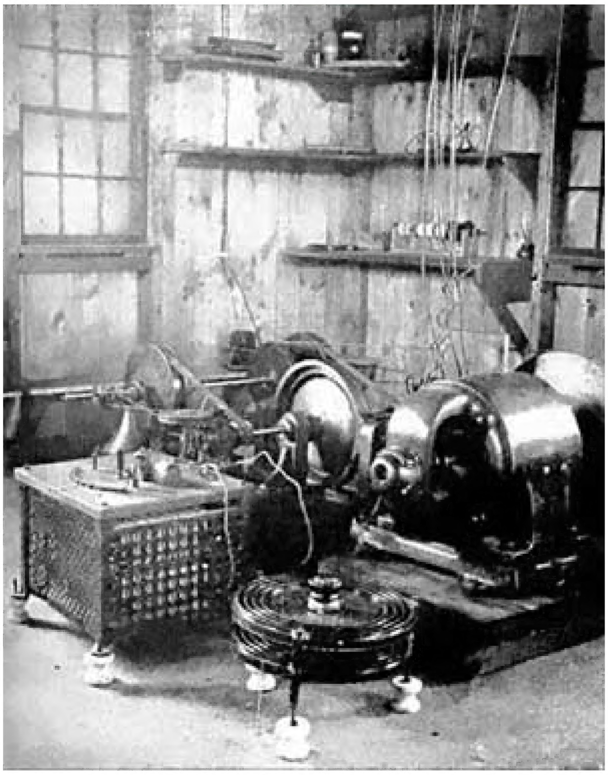


Fig. four

On Christmas Day, Monday, December 24, 1906 and at a pre-announced time, a large-scale public presentation of wireless telephony took place in Brant Rock [1]. In the transmitter (Fig. 2), an electromechanical sinusoidal oscillator (Fig. 4) with a power of 1 kW [2] and a frequency of 75 kHz (4000 m) was operating on a previously built antenna with a height of 128 m (Fig. 3). From a distance of 180 km in the Atlantic Ocean, ships were received by the US Navy and the United Fruit Company, which were previously equipped with advanced receivers with liquid detectors (Fig. 5). The AM signals carried on the air were also “noticed” south of the coast at a distance of 950 km at Fort Norfolk (Virginia).

The details of the first sound theater play on the microphone were described in detail by Fessenden himself in a letter sent to WHE Vice President Professor S. Kintner in January 1932. In accordance with the script, Fessenden first addressed the audience with an opening remark and then played an aria on Edison’s phonograph “ Largo ”from the opera“ Xerxes ”by F. Handel. Then Fessenden himself performed on the violin the melody of Sh. Guno “O, Holly Night” (“Divine Night”) with the simultaneous humming of the last words of the composition - “Adore and be still” (“Be humble and read”). Next came the turn of reading the Bible with the words “Glory to God in the highest and on earth peace men of good will” (“Glory to God in heaven and people of good will on earth”). At the end, Fessenden and the other participants in the performance (Fig. 6) wished everyone a Merry Christmas.

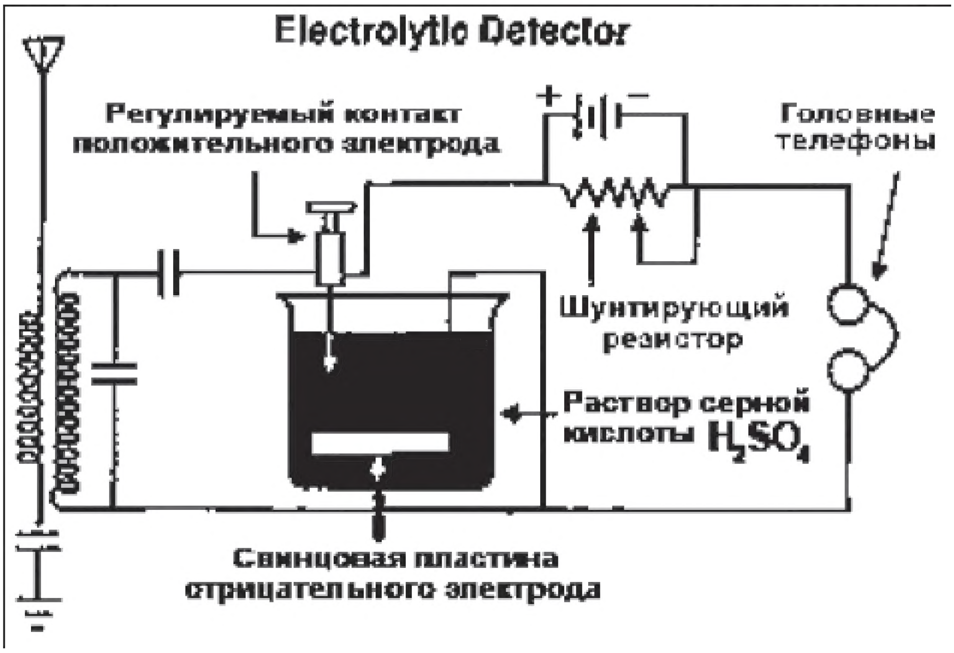

Electrolytic Detector
Регулируемый контакт положительного электрода
+
−
Головные телефоны
Шунтирующий резистор
Раствор серной кислоты H_2SO_4
Свинцовая пластина отрицательного электрода

Fig. 5

Fig. 6

With the addition in the form of choral singing, the program was repeated a week later on December 31 on New Year's Eve. This time a musical concert from Brant Rock was heard at an even greater distance - 2500 km on one of the islands of West India in the Caribbean.

The events that took place at the end of 1906 in a place remote from scientific centers provoked an ambiguous reaction even among the "brothers in mind". Bell made doubts similar to those he himself read 30 years ago in a review of his invention received from WESTERN UNION: " *It is unlikely that the device will ever be capable of sending legible speech a few miles away* ." Edison said that " *it is as impossible as to fly a person to the moon* ." Marconi considered the achievements of Fessenden hype and rattle in order to attract attention.

Due to the lack of explanations and advertising training in the editorial offices of newspapers and magazines, they did not understand the essence of Fessenden's technology, did not trust it, and considered it unproven. On the pages of publications, Marconi was painted successfully flying across the ocean, while Fessenden was portrayed with difficulty climbing onto the antenna mast, and then absurdly falling from it into the water.

The lack of interest in wireless telephony among financial and industrial circles forced the founders of NESCO to start selling the company. Fessenden was offered to quit the company. In the future, he did not return to work on the transfer of AM oscillations. Obviously, Fessenden did not know how to "serve" and "sell" himself, so he died in poverty and oblivion. For all this, in connection with the 70th birthday, a postage stamp was issued in Canada in honor of AM's father (Fig. 7).

Fig. 7

Alexanderson continued to improve alternators. In 1915, one of the generators, as excellent in technical characteristics, was bought from Marconi for the radio station under construction. In 1919, in the established RCA (Radio Corporation of America), Alexanderson took the place of chief engineer. Here, much has been done to them to establish regular AM transmissions. Responsible work in the new post began with the design and construction of the Central Communications Station on Long Island in New York. The use of Alexanderson generators and 12 high omnidirectional antennas made it possible to communicate with many countries.

In 1923, one of the generators and the antenna were installed in the homeland of the developer - in Sweden, near the town of Grimeton. The transceiver was operated until 1996. At present, an electromechanical generator tuned to a low fixed frequency of 17.2 kHz is stored as a national monument of antique equipment. In the middle of each year, on the "Alexanderson Day", he is included in Europe to transmit the callsign SAQ, coded in Morse code (1791-1872), throughout Europe. Russian hams take a strong part in the celebration of this day [3, 4].

In the spring of 1907, L. Forest (1873–1961), the inventor of the tube triode, experimented with the transmission of speech and musical signals. Instead of a spark generator, the next generation generator worked in the transmitter — an arc generator with an oscillating circuit that emits a given frequency of continuous EM oscillation. However, from the point of view of reducing excess disruption to a useful AM signal, the arc generator was slightly superior to the spark generator. Therefore, nothing came of the initiative to use a cheaper and less bulky RF signal source in exchange for the Alexanderson generator.

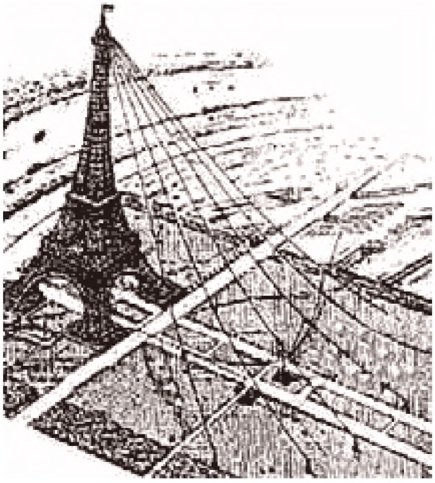


Fig. 8

The continued development of Fessenden and Forest was fundamentally prevented by the economic crisis that erupted in 1907 in the United States. Forest later more successfully broadcast performances from opera houses by superimposing musical signals from the RF on the carrier of the RF generator assembled on the electrovacuum device he invented.

Transmitting stations based on arc generators were developed for wireless telegraphy and were operated in this direction until the mid-1920s [5]. An example of the technical and spectacular use of such technology is the use, beginning in 1910, of an army transmitter and its antenna at the Eiffel Tower in Paris (Fig. 8). Signals from the highest building of the time (317 m) were carried up to a distance of 4000 km. Until now, the tower serves as a "stand" for antennas, only television ones.

Where did the "radio" come from?

The term "radio" (from the Latin. Radius, radiare, radio - to emit, irradiate, radiate in all directions) was first coined by the famous English physicist - chemist W. Crookes (1832-1919). In 1873, in a vacuum tube, using a balance beam, he measured the atomic weight of the waist element that he discovered and discovered a violation of the balancing of a high-precision instrument in the event of thermal radiation. A little later, a similar effect of light radiation was noticed. Based on the discovery, a measuring device - a "radiometer" was designed.

Subsequently, other devices invented by eminent scientists appeared containing the prefix "radio" in the name. The "radioconductor" (radio conductor) proposed by the French physicist E. Branly (1844-1940) for detecting electromagnetic oscillations in laboratory conditions is one of the most famous.

In 1892, in one of the English general journals, which wrote also about spiritualism, Crookes, who admitted contactless biological communication between the heads of people, published the article "Some Possibilities of Electricity". The Russian version of it can be found in [6–8]. The publication is considered the starting point for the interpretation of the concept of “radio”. Other terms stated in the text, such as generation, range, sensitivity, selectivity and others, also later became common.

Crookes did not conduct experiments on the technique of forming and receiving EM oscillations. However, the article described an imaginary receiving and transmitting installation. By selection, he understood the fixed tuning of the system, the allocation by it of an interval (range) of waves of cumulative width, for example, from 40 to 50 m or all transmitted by the human eye.

Surprisingly, the tuning of oscillatory circuits, already widely used in cable telegraphy, according to the formula of W. Thomson (1824-1907) known from 1853, $T = 2\pi\sqrt{LC}$, Crookes did not mention. He did not predict until the advent of wireless telephony. Over the years, in 1923, another famous English physicist O. Lodge (1851-1940) called the article “an amazing example of scientific prediction” [8].

With all of the above, at the end of the XIX - in the early years of the XX centuries in Europe, the term "radio" was not popular. Scientists and inventors in relation to telegraph or telephone operated with the phrase "wireless" in their opinion, more significant, arousing interest among engineers and technology lovers.

In 1909, in the American town of San Jose (77 km south of San Francisco), the founder and teacher of the local college of wireless telegraphy and technology, C. Herold (1875-1948) built a spark transmitter through which he began to broadcast speech programs, and then musical . They were accepted mainly by former and current students of the educational institution.

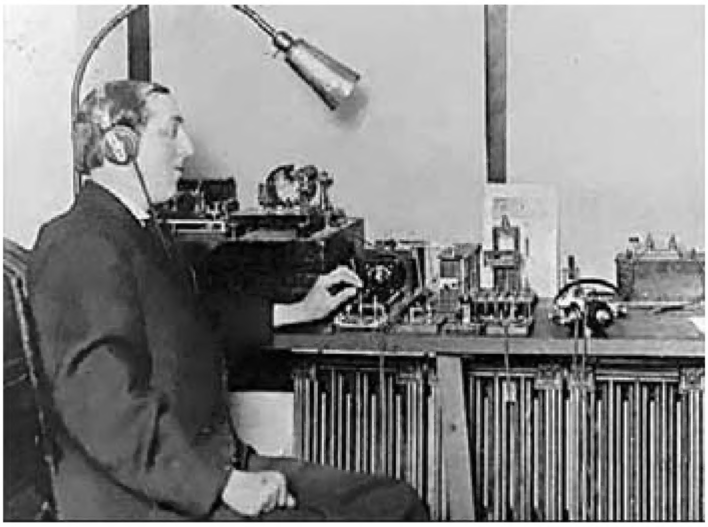


Fig. 9

Herold was born and raised in a farming environment, where on the field sowing seeds randomly called "broadcasting". Since the transmitter antenna in San Jose had a circular radiation pattern, it also emitted EM waves in all directions (scatter). By analogy with the agronomic definition, Herold began to refer to his broadcasts as "Broadcasting" (broadcast, broadcasting). The use of the term is fixed not only in the USA, but also in Europe. At the same time, the term “radio” began to gain widespread acceptance.

Herold (Fig. 9) improved the radio station. The spark generator in it was changed to arc, and then to a tube. He started broadcasting on a schedule published in newspapers in 1912. By the end of the 1910s, there were more than a hundred radio stations owned by companies and individuals in the United States and Canada. They broadcast news, stock quotes, concerts of jazz music [9].

By the beginning of the 1920s, technical prerequisites for continuous broadcasting were created in many developed countries. On May 20, 1920, in Montreal (Canada), beginning with a concert by jazz singer D. Lutton, regular broadcasts of the CFCF radio station went on air on an average wavelength of 360 m (833 kHz) [10]. The Americans disagree with Canada’s priority and suggest that the KDKA radio station in Pittsburgh, PA, began broadcasting regularly on November 20, 1920. In the same year, on November 22, the most powerful (5 kW) in Western Europe, located near Berlin, a radio station in Koenigs Wusterhausen (Germany) came into operation. At the end of 1922, the BBC began broadcasting in London (England). By the beginning of 1923, 500 radio stations already owned licenses for broadcasting in the US states [9].

Opening of Trinity and Rybkin, development of Popov

By the end of the 19th century, in developed countries, telegraphs and telephones used telephones (they were also called and called headphones). Along with this, when conducting trial experiments and experiments on the transmission of EM vibrations through the air, performed by Branly, Lodge, Popov, Marconi, head phones were not used. Their need for reading Morse code codes was obvious, as well as in telecommunications. However, it was not clear where to connect them. Despite the apparent simplicity of the technical solution to the problem now, none of the "great" European minds had the idea of connecting head phones with developed devices.

For the first time, sound telegrams were heard on a headphone in Russia. The event took place in May 1899 P.N. Rybkin (1864-1948) and A.S. Troitsky (1857-1918) - A. Popov's assistants, according to the program agreed upon with him, established communications between the Milyutin forts in Kronstadt harbor and "Constantine." On the advice of Troitsky, using headphones, Rybkin identified the cause of the malfunction in the receiver of Fort Milyutin. When the headphone was connected in parallel with the coherer (radio conductor), he heard loud telegraphic messages from the transmitting station of Fort Konstantin. A few days later, similarly, Troitsky received and deciphered sound impulses from a 26 km distance. and participating in the work of the destroyer number 115.

The discovery was reported to Popov, who was on a business trip abroad. Realizing the seriousness of the message, Popov interrupted the trip and quickly returned to Russia. Upon arrival, he praised the ability to receive intermittent signals "by ear" increasing the sensitivity of the receiving equipment. Over the course of a month, he developed three versions of "telephone dispatch receivers" with head phones without relays, electric calls, and mechanical "shaking" of the coherer. The scheme of one of them and the appearance are shown in Fig. 10.

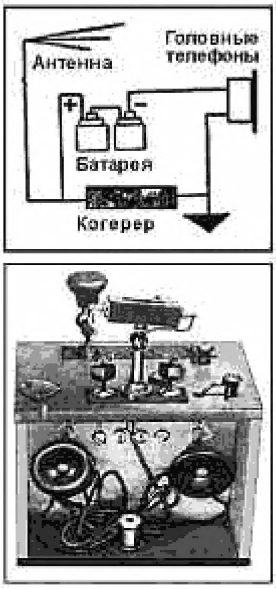


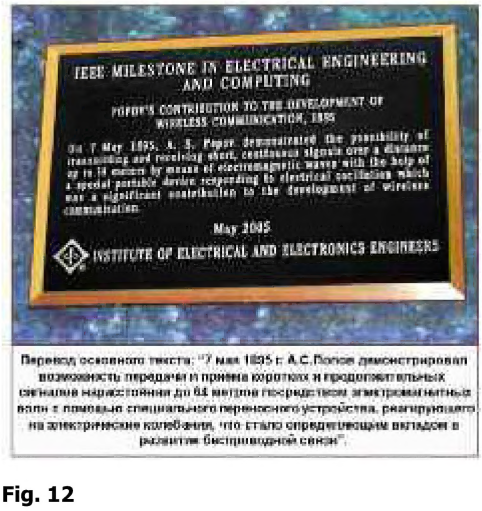
Fig. 10

Two months later, patents in the UK and France were received for the "parallel scheme" of Rybkin-Troitsky, and a "Russian privilege" was later issued.

In Europe and America, headsets quickly took root in radios, and became the main means of processing telegraph and telephone messages. Recording writing mechanisms began to be included only for documenting items.

Fig. eleven

The next 1900 was a year of triumph for Popov. For the development of a series of receivers with head phones, the preparation of their serial production by the Russian-French company Popov-Ducrete, a successful winter operation (1899, 1900) to rescue fishermen and the battleship General Admiral Apraksin in the Gulf of Finland, a set of previously completed work by telegraphy at the World Industrial Exhibition held in the second half of the year in Paris (France) he was awarded the Big Gold Medal (Fig. 11). The tsarist government paid him remuneration (33,000 rubles), equivalent to the Nobel Prize of that time.



IEEE MILESTONE IN ELECTRICAL ENGINEERING
AND COMPUTING

POPOV'S CONTRIBUTION TO THE DEVELOPMENT OF
WIRELESS COMMUNICATION, 1895

May 2005

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

Перевод основного текста: "7 мая 1895 г. А.С.Попов демонстрировал возможность передачи и приема коротких и продолжительных сигналов на расстоянии до 64 метров посредством электромагнитных волн с помощью специального переносного устройства, реагирующего на электрические колебания, что стало определяющим вкладом в развитие беспроводной связи".

Fig. 12

It is worth mentioning another important historical event that occurred after 110 years of the invention of the radio by A. S. Popov. In 2005, the IEEE Historical Center of the International Community (The Institute of the Electrical and Electronics Engineers - Institute of Electrical and Electronics Engineers, formed in 1884 in the USA) agreed with the request of the Russian Northwest Section of IEEE to establish a memorial plaque in the homeland of the inventor. In May 2005, a U.S.-made bronze commemorative panel was delivered to St. Petersburg and installed at the entrance to the A. Popov Memorial Museum at St. Petersburg State Electrotechnical University (formerly Institute), where he was a professor of physics and then director A. FROM . Popov worked until 1906. The appearance of the panel and the translation of the text are shown in Fig. 12.

The fact that at the end of the 19th century the solution of the problem of introducing head phones into radio equipment was by no means simple or trivial, the events associated with Marconi testify. In July 1899 and April 1900, he received positive opinions on the famous patents No. 12329 and No. 7777 for selective ("jigger" - sorting) receivers containing inductive - capacitive circuits. The development was carried out in conjunction with a team of highly qualified English specialists MARCONI COMPANY. However, at the stage of preliminary paperwork, this elite engineering "club" still did not know the method of using headphones. Therefore, they are not indicated on the diagrams in the patents.

At the same time, in December 1901, with the famous "throw" of a radio signal across the Atlantic, Marconi on the American coast of the ocean caught the letter S, relying not so much on selection as on a sensitive detector and a susceptible headphone connected according to the scheme [11, 12], indistinguishable from the "receiver of dispatches" Popov (see. Fig. 10). It is worth noting that Marconi used the head-phone "for free." since the United States was in no hurry to acquire the copyright license of Popov - Rybkin - Troitsky.

Broadcasting in Russia

During the First World War (1914-1918) and at the end of it, thanks to successes in radio engineering, in several European countries and the USA, government leaders made important statements and appeals to each other on the air.

In Russia, in the months preceding the revolutionary changes of 1917, powerful stationary radio telegraph stations were already operating in St. Petersburg, Moscow, Tver, the European part, as well as in Siberia, Central Asia, and the Far East.

Speeches by Russian statesmen on the air - appeals to the people began after the February Revolution. There were several of them during the year. On August 27, 1917, the head of the Provisional Government A.F. Kerensky (1881-1970) addressed the people on the radio in connection with the Kornilov rebellion in the army. On the same and the next day, August 28, the Supreme Commander of the Russian Army L.G. Kornilov (1870-1918) also addressed the nation. At about 19 hours on October 25 (November 7), 1917, the Provisional Government sent the last tragic notice on the radio, beginning with the words: "To everyone, to everyone, to all ...". Toward midnight, the newly appointed Chairman of the Council of People's Commissars (SNK) V.I. Lenin (1870–1924) addressed by radio telegraph to the message "To the Citizens of Russia". Five days later, Lenin, also starting with the words: "Everyone, everyone, everyone ...", reports on the formation of the first SNK and the adoption of decrees on peace and land. The texts of speeches were received at Tsarkoselskaya (later Detskoselskaya) radio station located near St. Petersburg, from where they were distributed to other stationary and field radio stations in Russia and Europe for reprint in newspapers.

In April 1918, SNK decided to transfer a number of powerful radio stations to the post and telegraph commissariat, including Tverskaya, chosen for international affairs. Two months later, a special "contingency bureau" appeared in the organization led by M. A. Bonch-Bruevich (1888-1940) . In August, a special research unit moved to Nizhny Novgorod and became known as the Nizhny Novgorod Radio Laboratory (NRL). There began the development of powerful generator lamps and the construction of the first domestic radiotelephone transmitter. On February 27, 1919 in the morning, instead of the usual Morse code, the appeal was broadcast in a male voice: "Hello! Hello! Says Nizhny Novgorod radio laboratory. One two Three. How is it heard? "[13].

The first radio concerts throughout the country were broadcast from the NRL on May 27 and 29, 1922, and their "audibility" extended to 3,000 km. In Moscow, the Central Radiotelephone Station (CDS), built by the NRL on Radio Street, broadcast a music concert on September 17, 1922. From September 8, 1924, the CDC, the most powerful in Europe (12 kW), also called RV-1, began regular transmissions on a wave of 3200 m. (93.75 kHz). On October 12, also in Moscow, on a long wavelength of 1010 m (297 kHz), Sokolniki Radio Station began to broadcast regularly, built under the direction of the future academician A. L. Mints (1895-1974). The end of 1924 is considered in Russia the beginning of regular broadcasting [9].

On July 15, 1924, the Council of People's Commissars organized the Society of Radio Amateurs of the RSFSR (renamed the Society of Friends of Radio of the RSFSR by the end of the year). In the first issue of Radio Amateur magazine (the progenitor of Radio magazine), which was published on August 15, 1924, the printed organ of society, the reader G. G. Ginkin put forward a proposal to introduce the concept of "broadcasting" as applied to all broadcasts of music and speech programs on radio [fourteen]. The term quickly gained recognition in Russia and other related countries.

Car radiotelephone

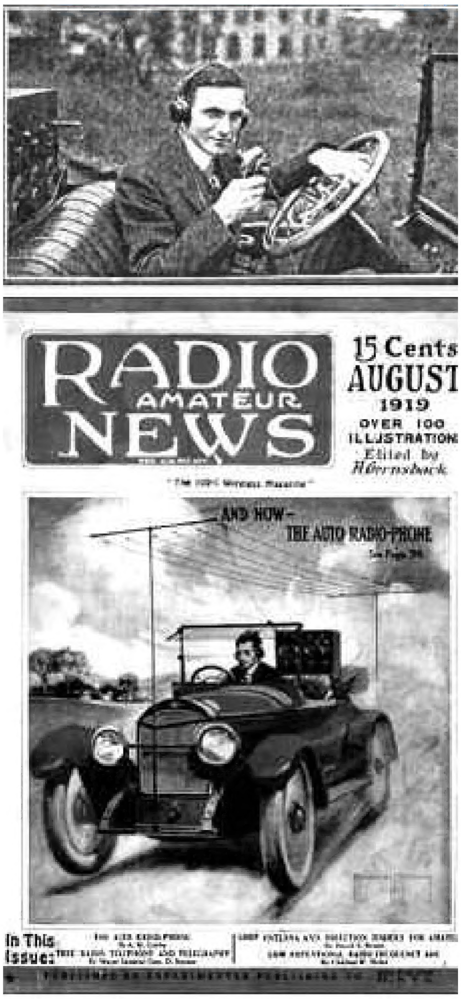


Fig. 13

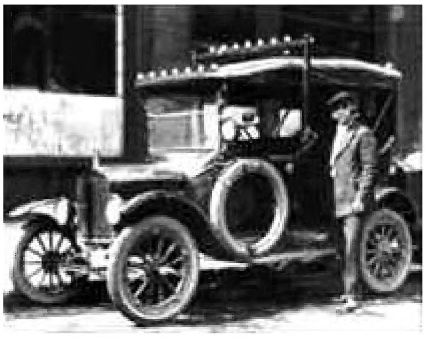


Fig. fourteen

After the start of the victorious march of radio telegraphy around the world, the radio room in which the operator received messages became an indispensable attribute of ground-based military and civilian organizations, marine vessels. But in small-sized high-speed modes of transport (airplanes, cars) there was no place for a radio room and an operator. At the same time, pilots and drivers cannot read the printed dots and dashes from the telegraph tape during movement. Therefore, they looked at the rise of radiotelephony with hope, hoping to join a new type of communication compatible with driving.

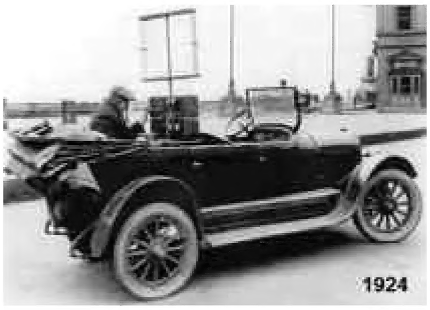
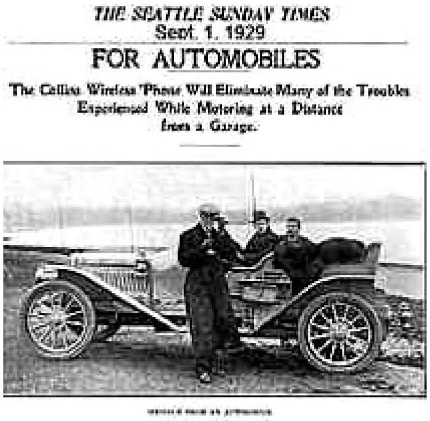


Fig. fifteen



THE SEATTLE SUNDAY TIMES
Sept. 1, 1929

FOR AUTOMOBILES

The Collins Wireless 'Phone Will Eliminate Many of the Troubles Experienced While Motoring at a Distance from a Garage.

Fig. 16

Now it seems strange, but in the 1910s, aviation, car manufacturers and radio engineers believed that it was better to stay away from planes and cars from transceivers. It was assumed that voltage fluctuations in radio devices could lead to a malfunction of electric ignition of the fuel in the cylinders and even an engine explosion, and the electric discharges of the ignition system, in turn, would create insurmountable interference to radio reception.

For the first time from a flying seaplane of the US Coast Guard, test radio signals from a distance of 225 km were received by a ground radio station in New Orleans (Louisiana) in September 1917. In October of the same year, voice radio communications was adopted; aircraft crews were recommended to talk at a distance of not more than 40 km between aircraft and 70 km from the nearest ground communication point. Around the same time, experiments were conducted in the U.S. Army on radio communications between an airplane in the air and a car in transit.

It is believed that for the first time a radio in a civilian passenger car was installed in the United States. To mount it there in 1919, the young businessman A. Greb ventured, remaining at the end of the First World War without earnings from military orders. Greb was also a radio amateur - he was fond of amateur radio communications, so in addition to the receiver he decided to install a radio transmitter in his own Buick passenger car. On top of the car on T - shaped racks he stretched a six-wire antenna (Fig. 13). A lamp-spark transceiver on a wavelength of 150 m (2 MHz) worked confidently in a radius of up to 250 kilometers. It was placed in the back seat, received power from a separate battery located below. Greb called the constructed mobile communications device "a car radiotelephone".

The equipment decommissioned from the army was manufactured at the Marconi American branch of the company. By the way, Marconi himself equipped his floating yacht, the Eletra laboratory, with voice telephony in the same 1919. A few years later, in the USA, police cars began to be equipped with auto-radiotelephones (Fig. 14). Following Greb's example, the auto-antenna was stretched on ceramic insulators on top of the roof. A more recent development of the autoradio phone with a loop antenna made at BELL LABS (USA) is shown in Fig. 15. However, as early as the end of the 1920s, few were able to talk on the auto-radiotelephone as seen in the picture from the newspaper (Fig. 16).

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The article was published in the journal "Radio" No. 10 of 2007.
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